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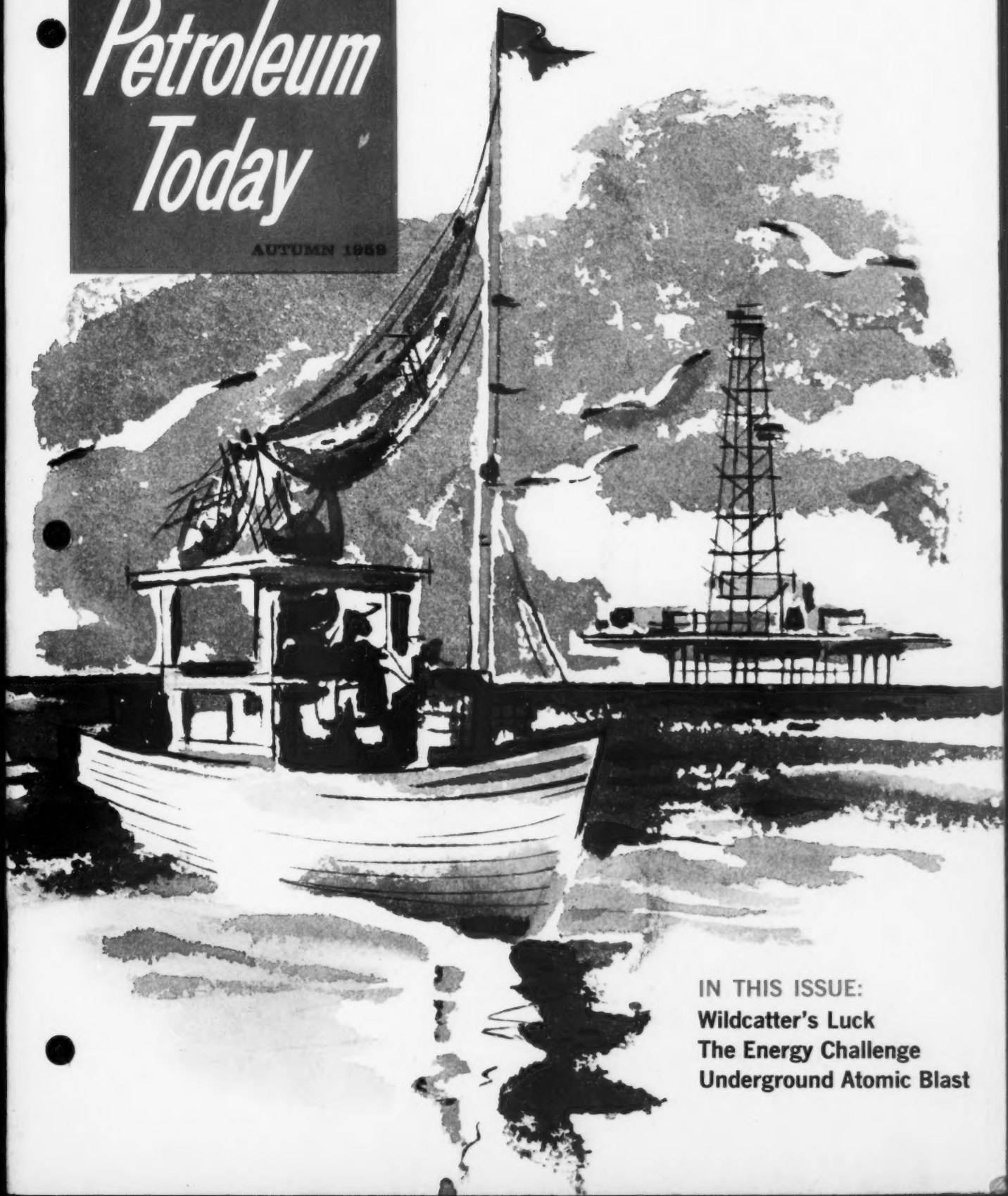

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Wildcatter's Luck
The Energy Challenge
Underground Atomic Blast

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COVER: The masts of a Louisiana shrimp boat and a modern drilling rig cut sharply into the horizon of the Gulf of Mexico. They symbolize two industries working side by side to provide America with nature's bounties.

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EDITOR'S NOTE:

This is the first issue of *Petroleum Today*, the new quarterly magazine of the American Petroleum Institute.

Petroleum Today is designed to acquaint readers with petroleum's achievements and its problems in supplying the basic source of energy, lubricants, and thousands of other products that provide the people of America with mobility, convenience, and well-being.

This country's progress has gone hand in hand with the progress of the petroleum industry, which now supplies over two-thirds of America's energy needs. The industry's ability to go on contributing effectively to the country's progress depends to a large extent upon public understanding of petroleum's achievements and problems. The purpose of *Petroleum Today* is to contribute to that understanding.

In the search for new oil and gas deposits, eight out of nine wells drilled don't pay off. Even the world's deepest hole was a "duster."

Wildcatter's Luck

by Robert W. Stock

YOU are speeding down a narrow strip of road cut into the arid prairie of Southwest Texas. Behind you is the town of Fort Stockton, bathed in the fire of a crimson sunset. Your destination: the deepest hole in the world.

The man behind the wheel is Wade Ramzy, drilling superintendent in this area for a major oil company. He is reciting facts and figures in a slow, calm drawl.

"We were out here 'bout two years, little better . . . Tryin' to tap the Ellenberger . . . Went down close to five miles . . . Hunh? Oh, I wouldn't know. Some people say it cost better'n $3 million."

Your car turns off the asphalt and up a deserted road made of crushed limestone. Along the way you see a jackrabbit poised for flight. In the distance a buzzard swoops toward its prey. "Just over the next rise," you're told.

At last it is before you. The world's deepest hole in the world.

A huge circle has been gouged out of the prairie, bare of even a clump of sagebrush. In the center of the circle a thin rusted pipe is raised a few inches above the ground. It is all that remains of University Well EE-1, one of the most spectacular dry holes in history.

They call them "dry holes" or "dusters"—these wells that fail. For men like Wade Ramzy they're commonplace, the rule rather than the exception. The University well was just one of 21,000 dry holes abandoned last year.

"That's what wildcattin' is," he says. "You're drillin' in unproved territory. You're always on the short end of the odds. They say eight out'a every nine wildcat holes drilled in this country are dry."

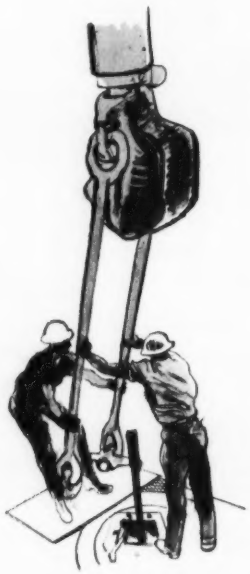
Wildcatting is a glamorous business, but it is the most frustrating business in the world. The late Mike Benedum was famed for his genius in finding oil. He was called the "King of the Wildcatters." But his favorite story was about a duster he drilled in Oklahoma. If he'd pushed the drill down another 130 feet, he would have discovered the immense Cushing Oil Pool.

Harold Boysen drilled 81 consecutive dry holes before he found a small field in South Texas. The late Jack W. Frazier put down 200 wildcat wells and 188 of them were failures.

A well can be just as dry out in the ocean. It's hard to beat the hard luck story of "Mister Gus," the famous drilling barge. While leaving the site

of a $1.2 million failure for another location in the Gulf of Mexico, "Mr. Gus," worth $3.5 million himself, sank to the bottom.

Companies have spent more than $12 billion in the search for oil and gas during the past five years, in this country alone—and the ante goes up each year. Deeper, more costly wells like the University EE-1 are increasing in number. And when they fail, their failure takes a bigger slice. Last year U. S. dusters cost more than $330 million.



But a wildcat well is more than an expensive hole in the ground. Its cost cannot reflect the excitement, humor, and heartbreak experienced by those who search for oil and gas. This is evident when you talk to those who lived through the 28 months of trials and tribulations of the University well—the geologists who selected the site, the crew who sank the casing 25,340 feet into the earth, and the townspeople who hoped the well would lead to a forest of derricks in their backyard.

Ed Van den Bark was boss man for the geologists who worked on University #1. He was in on the well from the start.

That was in the spring of 1955 when the company had exploration crews in the Fort Stockton area. Tests were run with a seismograph: explosive charges were set off and the course of shock waves under the surface charted. Results showed geological formations 18,500 feet below which might contain oil or gas but more likely the latter.

The area tested was part of the two million acres of public domain allotted to the University of Texas. Oilmen bid for leases on this land at public auction.

Geologists were assigned to follow the course of the well as soon as drilling began in October 1956. A year later, the 18,500-foot depth was reached without success. The monkey was on the geology department's back: Do we keep drilling or stop?

"We had to decide fast," says Van den Bark. "The rig operates 24 hours a day, seven days a week. Every hour we spent deciding was costing the company money."

The decision was to continue to 21,000 feet . . . from there to 23,000 . . . from there to 25,500. At each turning point the geologists were confronted with the same question. Each time the evidence favored going down deeper; each time the result was negative.

"We did prove out our seismograph tests," Van den Bark says. "We found the Ellenberger anticline. Trouble is, the stuff wasn't there."

Raymond Weatherford was derrickman on the University #1. His station was on the "monkey board," better than 80 feet above the rig floor. There he manhandled the lengths of drill pipe as they were raised or lowered from the hole.

"I was there from the beginning," he boasts. And, indeed, 12 of the 15 original crew members were still on the job when the well was completed —an exceptionally low turnover for a rig in an area where the temperature gets up to 104 degrees.

Weatherford scratches his head as he searches for the reason. "Well, it was a good rig. You know, good equipment and such." He means it was a safe rig. There was not a single lost-time injury during the entire two years—the green-and-white safety flag never flew at half-mast.

The original rig came from West Texas. When it was decided to drill below 18,500 feet, a portion of a rig from Icy Bay, Alaska, was shipped down. New equipment was developed to meet special problems.

There was one afternoon on the University well the lean derrickman won't soon forget. "I was up on the monkey board and we'd just brought up a mess of pipe from the hole and stacked 'em against the derrick. This ole wind blew up, must of been 60 miles an hour." Weatherford set to work tying down the pipe, thousands of pounds of it, the derrick swaying back and forth in the gale. "It was the only time I really worried a little," he confesses. "But she held."

C. J. Land, a husky 42-year-old, ran the rig from the well floor, supervised the derrickman and roughnecks. His explanation of the loyalty of the drilling crew: "We all got along pretty good."

There is little room for troublemakers on an oil rig. The heat, the danger, the constant roar of the machinery, the isolation—these cannot be borne without mutual trust and friendship. "The one thing you got to have is a sense of humor."

Rattlesnakes, for example. The men on the University well killed 15 of them by the rig. But

the only rattler they tell of is the "little ole bitty one" which surprised a roughneck in a nearby field. "Why, he just saw her and gave a big ole scream. Should of seen him clear that fence!"

Or nicknames. Everybody on the well had one. T. D. Atkinson, for instance—he was "bluehips." When Atkinson worked the monkey board he wore his blue safety belt low, rather than around his waist. Down on the floor later, the men looked at him and started to laugh. The color had worn off on his hips. Whenever they met Atkinson, day in, day out, the men would yell, "Hey, there's ole Bluehips."

Or blowouts. They're an ever-present danger on a deep well: pressure building up from below and threatening to send rig floor, equipment, and men hurtling skyward. There was one particular close shave on the University well, a stream of water from the well actually shooting to the derrick top. The crew recalls it with respect, but with a laugh as well. "Was a couple of greenhorns near the rig. They heard that blowout horn, lit out like a couple of jackrabbits. Those ole pencils and charts they had, they just went flyin' in all directions."

The fact that their well was headed for a depth record "perked us up a bit," as Land puts it. The first record to be broken was the Texas mark of 21,687 feet. Bluehips Atkinson was drilling when the world record fell at 22,570 feet—and he had just joined the crew a short time before.

"Here you men been drillin' on this rig for months and I ain't been here hardly a week and break the record," he crowed. "Dunno what's wrong with you boys!"

But the real excitement of the well was the same as it is for any wildcat: the chance of striking oil or gas. "We wasn't drillin' to break no records," Land says. "No, I suppose we don't get nothin' out of it personally if she comes in, but that don't make no difference. It's what we're all workin' for."

Ben Peeler is a soft-spoken young man, editor of the Fort Stockton *Pioneer*. He and his townsfolk were hoping, too—a new field would have meant growth and prosperity for Fort Stockton.

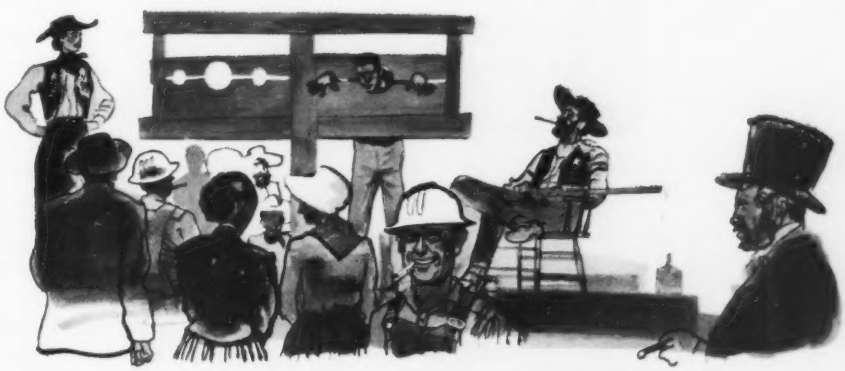
Even so, the University #1 contributed substantially to the economy of the community of 8,800. There were 18 men from the well, plus their families, staying in the town. They spent most of their earnings, about a quarter of a million dollars, right along Main Street.

As the drilling of the world's deepest hole entered the final stage, Fort Stockton folks were busy with preparations for celebrating the town's 100th anniversary. But, they weren't too busy to follow the progress of the well. "We ran stories every week," Peeler says. "And the Chamber of Commerce went out there and gave every man on the crew a special plaque when the Texas record was broken. Folks used to visit the rig, too, and KFST, our local radio station, taped interviews at the well."

The height of the centennial celebration came in the spring, shortly after drilling operations were suspended. By then, the Fort Stockton men were wearing beards and the women dressing in costumes of a century ago. Townsfolk who didn't play a part were subjected to mock hangings. Some even found themselves spending a short period of time with head and hands locked in a Colonial-type stock. "Don't know as any of the University well crew got picked on," Peeler says. "Guess folks realized beards might get in the way."

The Centennial might have been even more lively if the University well had come in. As Peeler puts it, "You know, we've never had a real big producer. It sure would of been nice . . ."

For all of them—geologists, crew, townspeople, company—the University #1 was a bitter disappointment. The order to dismantle the rig came in February of this year. The two years of work were wiped out in five days. Miles of pipe were lifted out. Down came the derrick. Platform and machinery were carted away. Until finally, the empty clearing and the few inches of pipe were all that remained to mark the deepest hole in the world.



The rig is back in action now, a few miles away. And many of the same men are working on her, hoping for the big strike.

River men never had it so good

WHEN I awakened, there was a hint of daylight settling over the river and I could hear the steady pounding of the towboat's big diesel engines. She was pushing her long tow of empty barges down the Ohio on the first leg of the regular eight-day run.

It was 5:30 and down in the galley Fred Skinner, one of the best cooks on the Ohio, would be feeding the men of the forward watch so they could relieve the other watch at six o'clock. I dressed and went down from my cabin on the texas deck, through the crew's lounge, the engine room, and into the galley.

Captain Willard White was there along with Chief Engineer Carleton Hargis, Third Mate Russel Bush, and two deck hands, Charley Kuhn and Stanley Tumlin. I sat across from Russ and asked him what time we had gotten away from the terminal. "I don't know," he said, "I was asleep." Captain White said he figured it must have been around 3:30.

He had told me the evening before that we should get away sometime between two and six o'clock in the morning. "Once they start pumping the crude oil out," he said, "it'll take 'em 14 hours. Then we have to make up the tow and pick up any extra barges they may want us to take back down the river with us."

Fred Skinner kept coming back and forth, trading hot biscuits for cool ones. On the table were orange juice and grapefruit halves, a big plate of crisp bacon and eggs, and chipped beef gravy for the biscuits. And there was a big plate of sweet rolls which went untouched until the coffee break at 9:30 that morning.

When the forward watch had finished eating, the men carried their plates to the galley sink. Before long, the other watch came in to eat. They had been on duty since midnight and had caught the heavy work of making up the tow in the rain

Capt. Carl Smith keeps his oil barge tow on course as the sun sets on the Ohio River.

Among them was the pilot, Gene Blatzell, with 31 years of river work behind him. He had been in the pilot house maneuvering the tow around since midnight.

It's always like this at meal time on the big boat. Men of the oncoming watch eat before going out to relieve the watch on duty. Then the men just off duty come in and eat before going to bed. It's six hours on and six off, seven days a week, holidays and all. The boat has to work steadily the year around and so do the rivermen who operate her.

Three days on their towboat had acquainted me with these men and the way they work and live. The trip had started in the middle of the week when I boarded the *Aetna-Louisville* at Cincinnati. She is one of eight boats that make up the largest towboat fleet operated by a petroleum company on the inland waterways.

Even when you live near rivers, as I have most of my life, and see the towboats working up and down the big streams, you tend to get a landlubber's exaggerated impression of what river life is like. You are prone to identify the passing scene with the men and times of Mark Twain.

But times have changed and so have the ways of the river boaters. A trip on a modern petroleum towboat soon makes you realize that there are two sides to this life—the air-conditioned quarters and the monotony, the fine food and the confining schedule, the good pay and spending half your life away from your family.

It was 8 a.m. when the *Aetna-Louisville* came into sight, pushing her long tow upstream beneath the Cincinnati bridges. A small harbor towboat put me aboard her, and Russel Bush, the mate on watch, showed me to my cabin. A few minutes later, I went up into the pilot house and met the relief captain, Carl Smith. Smith is an easygoing man of 35 who was piloting the river's biggest oil tows even before his 30th birthday. His work clothes are sport shirts, sharply pressed slacks, and polished dress shoes; not much here to remind one of the rough-cut river captains of steamboat days.

From the captain's chair, he can look down on his whole tow stretched out in front of him. There are eight integrated barges in the tow with two rows of barges side by side. The tow is 105 feet wide and 1,020 feet long. The length of the towboat is 150 feet. From the stern of the towboat to the bow of the tow, the distance is 1,170 feet or about a fifth of a mile. The barges have two and a half acres of deck space. An address system is used for communications between the pilot house and the lead barge when the tow is being maneuvered into locks or tying up at a terminal.

The men on duty in the pilot house are the ones who know the river best. They know where the sandbars are and where the buoys should be. They know all the bends in the river and the best ways to negotiate them. They also keep tabs on the passing scene ashore, noting where the hill farmers have planted their tobacco, the progress in construction of new houses, and so on.

The Ohio River twists through one of the world's most heavily industrialized valleys. Commerce has been growing steadily along the 981 mile course, from the Golden Triangle in Pittsburgh to the Mississippi at Cairo, Ill. Indeed, the Ohio River now has almost one towboat for every nine miles of its length. In 1947, Ohio River towboats moved 2,554,839,000 tons of petroleum products and ten years later the figure had jumped to 5,850,877,000. Petroleum holds first place in ton-miles moved upstream.

The efficiency of this busy waterway will be greatly increased by a current long-range program of navigation improvements. Modernization

Ohio River towboats move nearly six billion tons of petroleum products annually.

of the Ohio calls for deepening the channel from nine to 12 feet and replacing the 46 existing dams with 19 modern structures, whose locks will be 1,800 feet or double the size of the old ones. Thus, instead of breaking up their long tows and making time-consuming double lockings, the river captains can lock through in a single operation.

This will mean a major saving in Ohio River transportation costs. For example, it costs about $100 an hour to stop a tow and the new locks will cut lockage time from one and a half hours down to 30 minutes. What's more, there will be less than half as many dams along the river.

"It will cut down the time it takes us to make a round trip," said Carl Smith, "by a day or so. From our terminal at Owensboro, Ky., where we load, to our Catlettsburg, Ky., terminal is about a three-day trip on open river." Rivermen refer to an "open" river as one that is high enough to let them go across the dams instead of through the locks. It's a day slower when they have to lock through, and the new dams will make it almost like open river.

"It will make the crews' work a lot easier too," Smith added. "It's heavy work to have to break up a tow then make it up again when you go through the locks. And sometimes the way it is now, boats are stacked up at the locks for several hours getting through. You wait your turn."

He paused and pushed a black button that blew one blast on the whistle. "We're supposed to blow when we cross over a dam so the lockmaster can keep his records straight." We were pushing right over Dam 35 which spring rains had buried beneath several feet of water. Carl walked to the window and waved to the lockmaster.

Another towboat was moving downstream and Carl blew a single blast to tell him we would pass on his port side.

With the equipment in the pilot house of one of these modern towboats, there is little reason to tie up in any but the thickest fog and most restricted channel. A radar screen beside the captain's chair picks up every obstruction including the buoys in the river. It constantly shows the banks of the river and the position of the boat. A gyroscope shows how the tow is lined up in the river.

The captain of an oil tow determines how much of a load the boat will push, depending on the water level of the river. "When the river's in pool stage," Carl explained, "we usually put eight feet six inches of crude in the barges. This trip we have ten feet in them."

The load was 177,000 barrels on this trip but the boat has pushed as much as 200,000 barrels. An extra inch of oil in all the barges means that 1,064 barrels are delivered at no additional transportation cost.

Incidentally, it costs less to transport a barrel of oil on the 514-mile stretch of river we were covering than it does for the 12-mile truck haul from the terminal to the refinery.

An extra inch of oil in the barges means more ton-miles, and the crew takes great pride in the number of ton-miles its towboat makes for the year. "This boat's always ahead in ton-miles," Russ Bush said once when we were talking in the crew's lounge.

"It has been for six years," Hop Reid, the second engineer, added.

Carl Smith was less certain that one of the sister ships was better than the other. "Whichever one you're on," he said, "is the best one."

But for the captain, the question of ton-miles is a constant problem. With a towboat worth more than a million dollars and close to another million dollars' worth of barges and crude oil, he has a full-sized responsibility. "You don't want to run her aground coming up the river," Carl said, "but you don't want to come in with less than you can haul either. You can't afford to be scared to put on a little more crude. I listen to weather reports going down to get some idea of what the river stage will be when we come back up."

The up-river trip with the 177,000 barrels of oil in front of us was a slow one. Even this boat pushed the load at less than four miles an hour, against the swollen river. It took us two days and

The deckhand still is the muscle of a towboat.

nights to go from Cincinnati to Ashland, Ky. And once there, it took the shore crews 14 hours to pump the crude from the barges. The down-river trip, with empty barges and a strong current, was made at about ten miles an hour in only 12 hours.

I had a good opportunity to talk with every member of the crew. Most river boaters get into the work while they're young, often before they're 20. If they stay with it for a few years, they're likely to get promotions and pay increases. The better the pay gets, the more likely they are to stay with the work. Some of them, especially the younger ones with families, entertain hopes of taking shore jobs eventually.

"We have our choice," chimed in Stanley Tumlin who is under 30 and has four children, "of two different plans. We can either work 30 days on and 30 off and get paid for full time, or we can work on the 'nest egg' plan." This plan enables those who want to earn more to work a total of eight months a year, get four off and get paid for a total of 16.

"The way this usually works," explained Second Mate Walker Beemer, "is that we stay on the boat 40 days then take 20 off, or stay on 50 days and take 25 off. If you have a family you can use the money."

"We get our room and board too," noted Beemer. "We each have a private air-conditioned cabin. There's a laundry on board where we wash our clothes, and there's a television set in our lounge."

River boaters have seen many amenities added to their life. But there is still a lot of heavy work on the decks and the deck hand is still the muscle man of the river towboat. His heaviest work comes when the barges are being lashed together into a single tow. They're bound to each other with two-inch ropes and steel cables an inch and an eighth thick. The cables are pulled drum tight with ratchets which weigh 90 pounds each.

It usually takes several hours to put a tow together, and temperatures on the deck can be bitter in winter or blistering in summer. A good deck hand takes pride in the way he handles lines and the good condition of his boats and barges. He takes pride in moving about the decks in all kinds of weather without endangering himself or his boat's safety record.

The deck hand attaches the heavy hoses through which oil is pumped into and out of the barges. He also does the deck work on the towboat as well as on the barges and about once a year helps paint the boat.

The heart of the towboat is the engine room. The three gleaming white 16-cylinder engines that power the *Aetna-Louisville* once served in wartime amphibious operations. Each of them drives a huge screw with an eight-foot diameter. Together they give the boat 4,800 horsepower.

"When we're running full bell," said Hop, the second engineer, "we burn 6,400 gallons of fuel in a 24-hour day. If it's a cold day, we'll burn more than 7,000 gallons."

The trip down the river went fast. We had only one extra barge to tow. A few trips earlier, the crew had brought down-river a record tow that covered 5½ acres. When the river is open, the company gives them extra barges to drop off on the down-river trip. Often these barges contain finished petroleum products ready for delivery.

When we were still ten miles upstream from Cincinnati, Gene called Columbia Harbor on the ship-to-shore telephone and asked for a craft to take me ashore.

I put my cameras and clothes together, then took a quick turn through the boat to see the crew members who were on watch. Before long the harbor tug was alongside, and I stepped over onto her deck. Willard White waved from the pilot house and Fred Skinner from the galley door.

The big, smooth running towboat hadn't even slowed down. She seldom does in her steady movement up and down the Ohio, racking up records in ton-miles of petroleum moved.

Towboat "chow" is as good as it is plentiful.

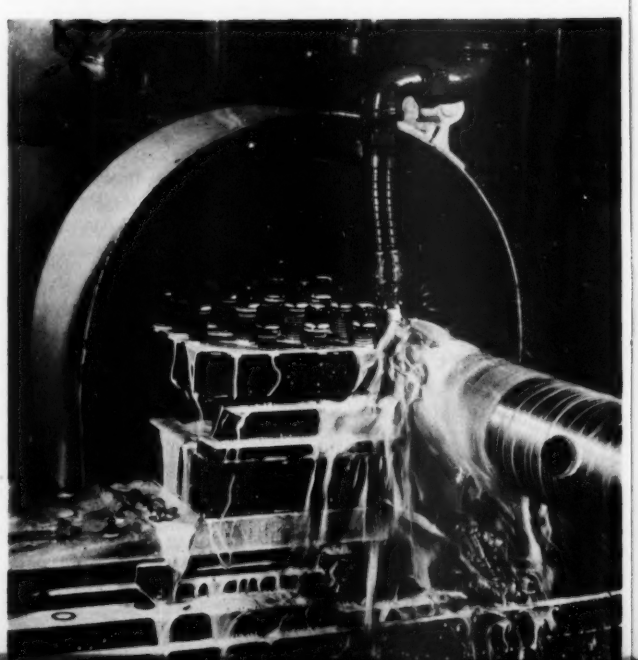
TURNING THE WHEELS OF PROGRESS

In an observatory, less power is needed to turn a 500-ton telescope around than it takes to turn a door handle. In a factory, a machine tool moves into position one-tenth of one-thousandth of an inch at a time. Such ease of mobility and precision are made possible by scientifically developed petroleum lubricants.

Nearly all the labor performed in the United States is done by machines which depend upon petroleum for lubrication. The hundreds of different kinds of lubricants are tailor-made to give machines higher speeds, greater precision, and longer wear.

As one lubricating engineer put it recently: "You just couldn't run many of today's machines with lubricating oils that were wonderful in the 1930's."

The paper industry provides a good example.



Steelmaking is only one of the thousands of U. S. industries which rely upon oil lubricants.

In the 1930's, paper for household tissues rolled off a machine at the rate of a thousand feet a minute. Today, with a newly developed oil lubricant, paper comes off the machines at a mile a minute.

As new industries are created, specialized oil lubricants are developed to meet their needs. For instance, a lubricant which would operate satisfactorily at 90° below zero was developed for the manufacture of penicillin.

Modern lubricants owe their specialized characteristics both to advanced refining processes and to the use of additives—chemicals. These chemicals are commonly used to make oils more resistant to thinning or thickening, to protect them against deterioration at high temperatures, to improve wear prevention characteristics, and to provide antirust, antifoam, and anticorrosion properties These additives enhance the working properties of well refined, selected lubricating oil stocks.

The special characteristics that can be imparted to lubricants are legion. Lubricants that keep giant power-plant turbines in good working order have long been a good example of the refinements made possible by specialized refining and suitable additives. Turbine oils have been developed to meet such diverse requirements as oxidation stability, protection against rust, resistance to foam, and good water separation. The oil put into a steam turbine is expected to last the life of the turbine, with proper filtration and necessary replenishment.

Perhaps the most exciting role ever played by modern, top quality, additive-type lubricants is in connection with the electronically controlled, multipurpose machine tool—latest of the revolutionary developments in the metal-working industry. For years, special lubricants have been used as fluids in

Petroleum lubricants provide high efficiency for precision cutting.

hydraulic systems which power machine tools. But now, these lubricants actually perform the function of control.

The electronic machine tool is virtually a factory in itself. Directed by magnetic tape, it performs any combination of more than 30 operations —milling, drilling, reaming, tapping, boring, etc. There is no retooling necessary, just a flick of the wrist to turn a dial that changes the tape.

The unit includes a 17½-ton table which is shifted in any direction to bring the workpiece in contact with the tool. Hydraulic oil fluids and lubrication allow the table to be shifted smoothly by one-tenth of one-thousandth of an inch. To get such close tolerances, the oil lubricants must be surgically clean with no particle larger than ten millionths of an inch permitted.

One of the most impressive uses of hydraulic power is at Mount Palomar, California, where lubricants help to operate the million-pound Hale telescope. The huge star-gazer and the dome that covers it virtually float on pools of lubricating oil, specially prepared to meet the exceedingly sensitive demands of the job. The telescope and dome turns smoothly and easily with the power of a little 1/12th horsepower motor.

Smooth performance is a must, too, for high speed precision operations in industry. Oil lubricants reduce friction and wear and withstand high temperatures created by high-speed machines. High speed puts the mass into mass production.

The steel industry has rolling mills that can turn out steel at more than a mile a minute. Metalworking plants achieve microscopic precision with tools such as grinding wheels that have a surface speed of 5,000 to 6,000 feet a minute.

The needs for high speed lubrication are many and varied. Many are found in the home, such as portable electric drills, power saws, and even vacuum cleaners.

Oil lubricants have a number of applications that don't readily come to mind. Take, for instance, their use in maintenance of San Francisco's Golden Gate bridge and the George Washington bridge linking New York and New Jersey over the Hudson River. Suspension cables are impregnated with highly adhesive oil lubricants that form a plastic, brittle-resistant coating to keep out moisture. The lubricants also keep these cables flexible.

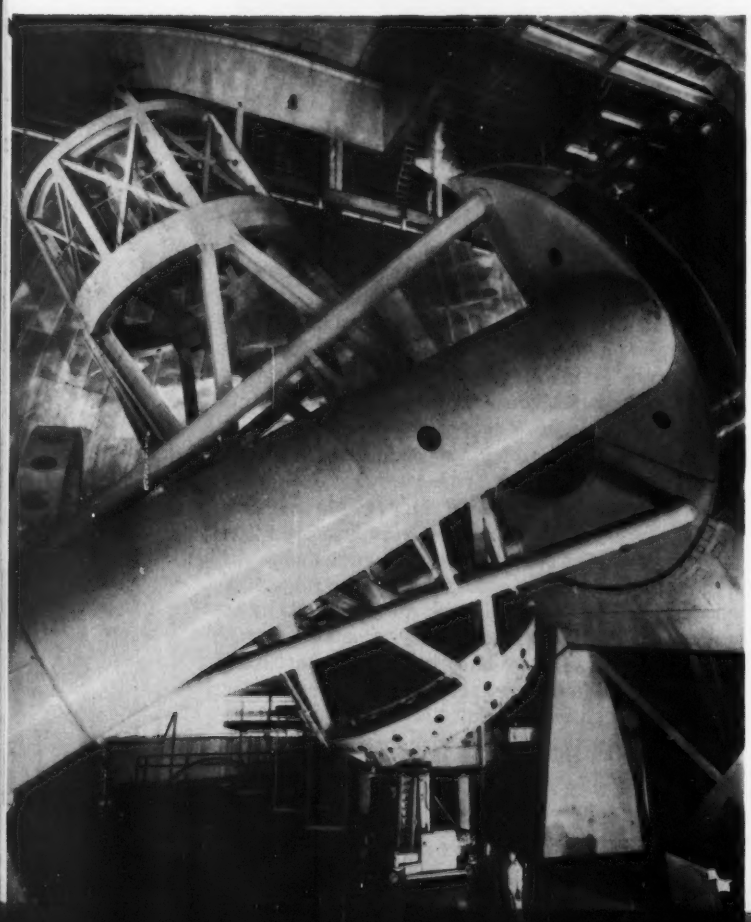
The rock drills used in the construction of harbors, dams, and buildings provide another important role for oil lubricants. For these jobs, lubricants must be designed to stand up under the impact of 1,600 to 2,200 strikes a minute and in a damp and dirt-charged atmosphere.

Transportation facilities of all kinds depend almost exclusively upon petroleum lubricants to keep them in motion—the nation's nearly 57 million passenger cars and more than 11 million trucks, its railroad rolling stock, its planes, and boats. Even the simpler forms of transport like tricycles, baby carriages, and wheelbarrows squeak, rust, push hard, and wear out if not properly oiled.

Around the home, the oil can remains the principal means of administering a shot of lubrication to anything from a squeaky door hinge to a sluggish lawn mower.

In the factory, the oil can generally has been supplanted by a more complicated device. It might be the familiar grease gun or it could be a mechanical oiler operated by a dial control.

Machines, which depend upon petroleum for all of their lubrication and almost three quarters of their fuel, now do 99 per cent of the labor performed in the United States. They enable today's workman to produce five times as much as he did 100 years ago.



The million-pound Hale telescope turns with precision and ease on pools of oil lubricants.

Oil Field Fables...

The Gullible Skeptic

When oil activity is new to a region, landowners are likely to be overzealous about the prospects of a strike on their property.

In the early days of oil, it was often difficult to convince a landowner that an unsuccessful wildcat well was really dry. Disappointed property owners frequently spread rumors that oil had been found but that the hole had been plugged or the oil cased off by a driller, who had been bribed by a rival company. Or, sometimes the rumor would be circulated that the company had plugged the hole because it wished to lease additional land cheap before admitting there was oil.

The prize skeptic among landowners—and the most gullible—was a Louisiana lessor. Determined to protect himself against any possible skullduggery, he demanded that a clause be put in the lease requiring the company to furnish him an electrical log of the well. The accommodating lease man, deciding to go the lessor one better, persuaded him to accept the following agreement instead:

"If a well should be located on the surface of the land herein leased, then in lieu of the Lessor being furnished an electrical log, Lessor shall have the right to be lowered head-first down the casing equipped with a two-cell battery flashlight, to a depth of 7,000 feet, or some lesser depth if heaving shales be encountered. Lessee agrees that Lessor will be lowered at a rate of speed not to exceed that rate which any prudent operator would lower his Lessor into a well bore. It is further understood that if lowering line should part, immediate fishing operations shall be commenced, and in no event shall Lessor be cemented in plug and abandoned." **Mody C. Boatright**

Professional Hazard

In areas where the devil himself was thought to be a lawyer, distrust of company lawyers frequently hampered lease deals.

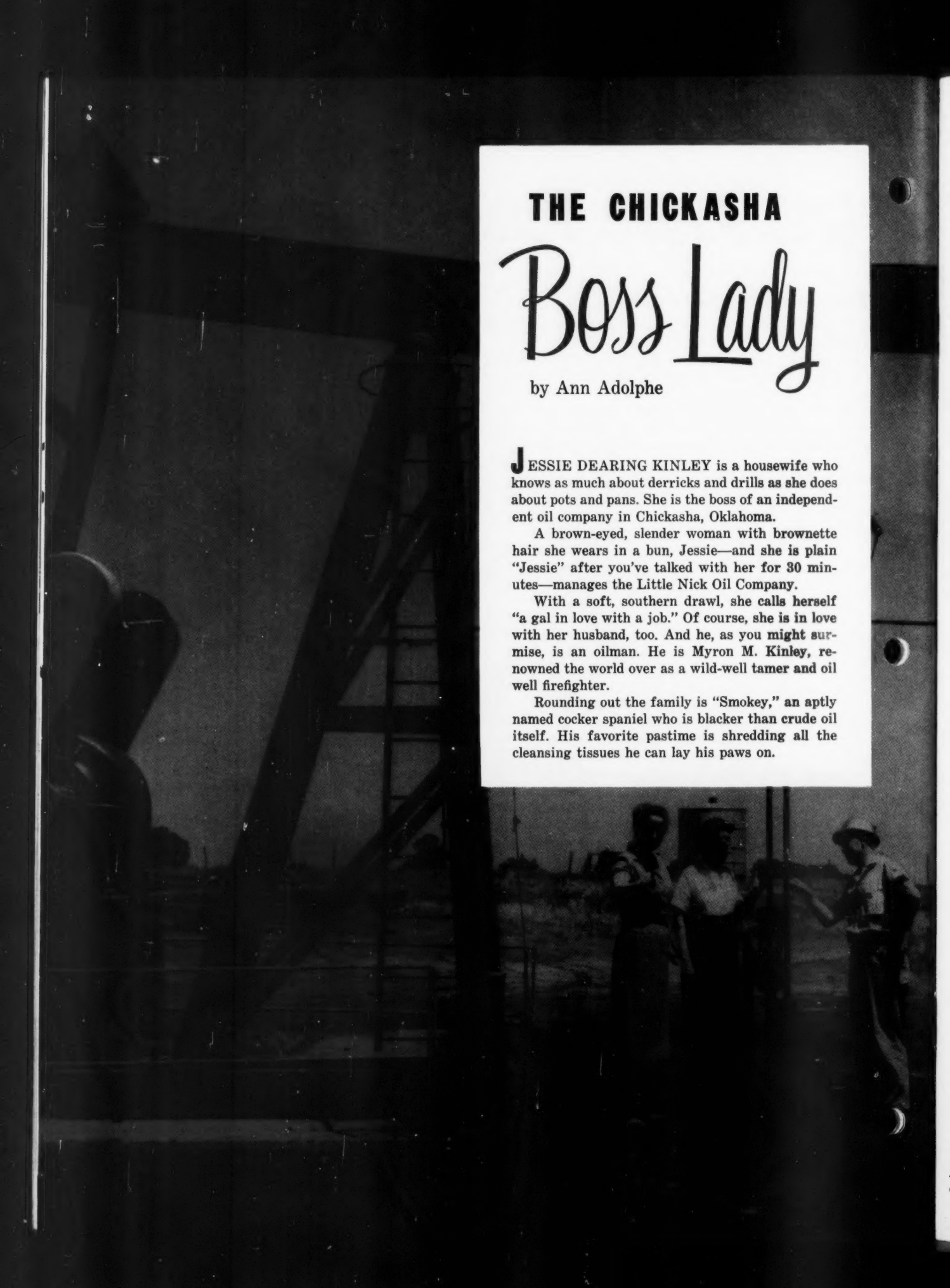
A young Gulf Coast lawyer learned this professional hazard the hard way. Soon after joining the company, he was assigned to help a lease man acquire rights to a highly desirable tract. The location was accessible only by boat across a bayou. The owners, an old man and his wife, were highly suspicious of oil companies.

As they crossed the bayou in a hired boat, the lease man outlined his plan. The lawyer would remain in the boat hidden by marsh grass. At a signal, a white cloth waved from the porch, he would go to the house and sign the papers.

All day long the lawyer stayed in the boat in the hot sun—hungry, thirsty, half eaten alive by mosquitos but afraid to take his eyes from the house for fear he would miss the white cloth.

Toward sunset a tired, irate lease man returned without the lease.

"They won't sign," he said bitterly. "I had it all worked out, but when I told them I had a lawyer in the boat they quit. They said they knew all along I had something to hide. They've decided to wait for somebody honest enough not to need a lawyer." **William A. Owens**



THE CHICKASHA Boss Lady

by Ann Adolphe

JESSIE DEARING KINLEY is a housewife who knows as much about derricks and drills as she does about pots and pans. She is the boss of an independent oil company in Chickasha, Oklahoma.

A brown-eyed, slender woman with brownette hair she wears in a bun, Jessie—and she is plain "Jessie" after you've talked with her for 30 minutes—manages the Little Nick Oil Company.

With a soft, southern drawl, she calls herself "a gal in love with a job." Of course, she is in love with her husband, too. And he, as you might surmise, is an oilman. He is Myron M. Kinley, renowned the world over as a wild-well tamer and oil well firefighter.

Rounding out the family is "Smokey," an aptly named cocker spaniel who is blacker than crude oil itself. His favorite pastime is shredding all the cleansing tissues he can lay his paws on.

Jessie's work is far afield from housekeeping which, interestingly enough, was her entree to the oil industry 25 years ago. It was in the depression summer of 1934 that Jessie went to work in the home of Mr. and Mrs. John Nichlos, the owners of the Little Nick Oil Company.

A girl from the farm community of Blair, Oklahoma, Jessie was attending the Oklahoma College for Women in Chickasha. She was only a year from becoming a school teacher. But, soon, Jessie and Mr. and Mrs. Nichlos became close personal friends, and the education field lost a candidate.

When Jessie returned to college in the fall, she switched her courses and took shorthand and typing. She was graduated in 1935 and went to work for Mr. Nichlos in the oil company offices.

Jessie recalls that, "My starting salary was $35 a month, but I doubt that I was worth it. What I lacked in ability, I made up for by being ignorant that I lacked it. I didn't know my own weaknesses, so I didn't let them stand in my way."

Perhaps she did lack stenographic ability, but she had one quality that was—and is—outstanding. She learned what she needed to know, and learned it fast. In two years, she took over the company's books along with her stenographic duties. For five more years, she stayed in the office and learned the workings of an independent oil company. By 1942, when John Nichlos died as the result of an accident, Jessie was capable of carrying on the business operations for Nichlos' widow.

Nichlos, himself, had never been too busy to help Jessie learn the business. But, at one time, he told her: "If anything ever happens to me, you must not try to do any drilling. It will drive you crazy." But, despite her late employer's advice, Jessie knew production would drop unless the company continued to drill. Typically, she prepared herself for getting into the production phase of the business by going out into the Chickasha and Cement fields to observe operations and to get information first hand from geologists, drillers, and crewmen.

Once committed to carrying on production, Jessie asked no special prerogatives as a woman. When there was trouble, Jessie, like any other operator, stayed at the rig all night, napping in her car and drinking coffee in the "doghouse" (a small house located on the rig floor or nearby and used for keeping records and storing small items).

But until July 17, 1944, Jessie hadn't known what real trouble was and her "doghouse" nights and days had just begun. On that July Monday, she telephoned her drilling superintendent, who was handling one well for her and a couple of wells for another independent. The telephone operator at Cement, Oklahoma, said, "I can't reach him right now. His well just blew wild." Jessie asked, "Whose well is it?" "I think it's yours," the operator answered. It was!

Jessie got to the well as fast as she could, and quietly took command of the situation. Her first move was to call in experts for advice. In their judgment, the best way to kill the blow-out was by drilling a directional well. (This meant drilling a hole at an angle to the bore of the producing well which would permit the injection of mud and water to plug up the wild well.)

The decision to undertake directional drilling was a big one. No directional well had ever been drilled in the Cement field. Formations there are such that it is difficult to drill even a straight hole. But, once convinced that this was the best solution, Jessie went decisively ahead.

Though difficult under the best of circumstances due to the geology of the formation, the project was made more so by wartime shortages. Even with priority, drill pipe and casing were hard to find. It was necessary to borrow some equipment from other producers. And, Jessie even made advertising appeals for critical items.

It took ten long, tortuous months to drill the directional well. A quarter of a million barrels of mud and water were pumped into the formation before the well was killed. Today, if she needs a comparison for an ordeal, Jessie refers to "the time the well was wild."

During her "ordeal" she found time to keep a journal of events. There is a complete record of the behavior of the wild well and the progress of the directional drilling. There also are entries of a more personal nature, such as: "Notice to move!" and "I bought a house." Another read: "Acquired Smokey. I couldn't have lived through it without him." And, so typical of Jessie: "Discussed directional drilling with the minister for two hours."

Jessie in her office examining an electric log of a deep well.

Jessie Dearing Kinley, the manager; Mrs. John Nicklos, the owner, and production man Bill Clark inspect a Little Nick Company well.

The directional well cost the company a third of its gross revenue for two years, but Jessie kept the company financially stable. One persistent skeptic, expecting a woman-run, woman-owned company to throw in the sponge under the circumstances, had to be told several times: "No, Little Nick is not for sale."

When it was all over, Jessie had won the respect of every oilman in the field. She had handled every crisis like a true "oilman." Even the directional well was developed into a small producer.

In 1949, Jessie and a number of other lease holders in the Chickasha field decided to drill a deep test well. When one of the major backers cancelled out at the last moment, the others withdrew, too. Jessie was not to be stopped, though. She decided to go it alone. In all, it took two years and $600,000 to drill 15,800 feet. Much valuable information was gathered, but only a little production was achieved. Since the project was financed entirely by Little Nick, all the information was, and is, known only to Little Nick.

During the drilling period, not even information on depth was given out. Each morning when the drilling superintendent called Jessie to report on depth reached, he simply said, "We're at 32, we're at 56," etc. He usually called from the same little store near the well site, where the woman storekeeper persisted in eavesdropping in an effort to learn how deep they'd gone. Frustrated in her efforts to get information in this manner, she pestered the driller one day to tell her. Figuring some answer was better than none, he replied "Well, I don't know for sure, but I think we're down about 100,000 feet." (World record for depth is 25,340 feet.)

"Oh," countered the storekeeper, "you know you're deeper than that. You've been drilling for two years!"

Jessie wishes it were partially so. She still isn't satisfied. She is sure that deeper than they went is a "beautiful sand," and she is eager to know what the drilling bit might encounter.

Typical of oil people, Jessie can spin yarns by the hour, loves doing it, and does it extremely well. Sometimes, her sense of humor is a bit frustrating to men who come to the company office. They frequently assume that an oil company manager by the name of "Jessie" is a man. Once she kept a male visitor squirming for at least half an hour before she introduced herself as the manager.

As devoted as she is to her job, it is far from being her only interest. For one thing, she is fond of classical music and she frequently goes with Mrs. Nichlos to the opera in Dallas. It was through her music appreciation that she came upon what was to prove to be a large-scale project. Alongside a magazine advertisement for classical records, she saw an article on destitute children in foreign countries. She decided that for what she was spending in records, she could "adopt" a child.

Jessie plunged into this new venture with her usual enthusiasm. She adopted not only the child, but its mother and the other two children in the family. She set about ordering clothing and staples for the family. She wrote regularly and a warm friendship developed. Later, Jessie arranged for the whole family to come to the United States.

At home, Jessie enjoys gardening and cooking, but has little time for either. Also, she devotes as much time as possible to civic projects.

Jessie was married to Myron Kinley in November 1958. As the industry's ace troubleshooter, Myron is always on call to all parts of the world to direct operations when a well blows wild or catches fire. When there is no pressing business in Chickasha, Jessie goes along. Naturally, she has a much keener appreciation of the problems of dealing with a wild well than the average person. Their conversations range from geologic formations to the honeysuckle (which Myron may have pruned too drastically), and there's a sprinkle of humor.

Typical of her wifely comebacks was when Myron telephoned her recently that one of his own wells was on fire. "My goodness, Myron," quipped Jessie, "is business that bad?"

Jessie and her husband, Myron, look over plans for a new house.

"Smokey" eagerly anticipates his sport of shredding tissues.

Airborne repair men save farmers costly delays.

Sportsmen fly to a remote Montana fishing site.

THE PRIVATE FLYING BOOM

by C. L. Hamilton *Managing Editor, Flying Magazine*

C. E. CHASE, who supervises a crew of Fuller Brush men in 19 spacious Nebraska counties of almost 13,000 square miles, got tired of covering his territory by car. So, he took flying lessons, purchased a plane, and now gets places in hours that formerly took him days by car. Where communities lack an airport, Chase simply gets permission from a farmer to land in one of his fields.

Chase's plane is one of 30,000 aircraft that comprise the nation's business fleet. Among them are more than 6,000 multi-engine planes as compared to 1,800 multi-engine aircraft operated by the scheduled airlines.

Though business flying is the fastest growing element of American aviation, it is only a part of "general aviation"—as all non-airline civil flying is called. Another 40,000 planes, primarily single-engine, are used in utility flying, commercial charter and air taxi operations, flight instruction, and pleasure flying.

Utility flying includes a wide range of "workhorse" activities, such as crop dusting; pipe, power, and telephone line patrol; mineral prospecting; aerial mapping and photography; and forestry, harbor, border, and traffic patrol.

General aviation, and particularly business flying, is a peculiarly American development. It is not yet a significant factor in the rest of the world. Indeed, the state of California alone, with 7,970 private or corporate owned planes and 42,139 actively licensed civil pilots, has more civil planes and pilots than all the rest of the world combined outside the U. S. The same can be said of Texas, Ohio, Illinois, Michigan, and New York.

Corporations and individuals own a fleet of 30,000 planes that are used primarily for business flying.

Wartime aviation was a potent stimulus to the growth of general aviation. Thousands of Americans learned to fly during the war and returned to business, industry, and agriculture with a new outlook—a new yardstick with which to measure time and distance. In the immediate postwar years, additional thousands received flight training under the GI Bill.

The air travel requirements of air-minded businessmen could not be fulfilled by the airlines alone, despite the rapid expansion of scheduled service after the war. Even today, the airlines are serving only 600 cities and many of these with limited schedules. But there are 5,000 additional airports, at least 4,000 of which offer commercial service facilities to civil general-aviation aircraft. Into these fields fly the fleets of American business, supplementing the high-speed, long-distance service of the commercial airlines.

Today, a community without a nearby airport is just not on the map. When the St. Lawrence Seaway opened the Midwest for industrial expansion, teams of industrialists toured the area, searching for plant sites. The first communities visited were those with airports and the first questions asked of city fathers concerned facilities at the airports for handling business aircraft.

The average general-aviation airport does not have to be an expensive installation. By far the majority of business planes can use comparatively small, smooth turf fields, or 3,000 feet of hard surface strip. To adequately serve such planes, the airport should make available 80-, 90-, and 100-octane fuels, a licensed aviation mechanic with a shop for maintenance and minor repair, runway lighting, and rental or courtesy car transportation to town. To attract and hold its business fleet customers, the operation should be as neat, efficient, and well-managed as a highway auto service station—the same merchandising techniques apply. None of this is beyond the financial capability of any community which wants to attract new business and industry.

Business flying has an outstanding apostle in Thomas J. Watson, Jr., president of IBM. A pilot since 1934, when he learned to fly while attending Brown University, Mr. Watson served as a flier in World War II. After the war, he found that his own plane often provided the best means of reaching IBM's nation-wide plants. And, eventually he decided to experiment with a company fleet.

Contractors use single engine planes, the workhorses of utility flying, to inspect operations.

Securing a top-notch commercial pilot, he started a regular daily flight between IBM plants at Poughkeepsie, N. Y., across the Catskills to Endicott—a day's drive for engineers, executives, and other personnel. Keeping records of the entire operation—every dime of expenditure, miles flown, and personnel carried—the company eventually convinced the Civil Aeronautics Board that the route justified service by a scheduled local carrier. IBM's planes supplement this service when needed and continue to operate regularly to other plants around the country where other means of transportation are either nonexistent or too time-consuming.

In a national economy as dynamic as ours, there

A patrol plane inspects rail crossing of The Great Salt Lake.

is profit in many things—in expansion of markets, in flexibility of management, in immediateness of service, in being first competitively, in ability to meet emergencies. The aircraft weighs heavily in all these factors.

As Colonel Willard F. Rockwell, chairman of the board of Rockwell Standard Corporation (which recently purchased a business plane manufacturing firm) stated in the October issue of FLYING magazine:

"The urgent need for executive mobility has multiplied at an even greater rate than our general economic growth. Decentralization of industry and shortage of executive manpower all contribute to the pattern which for some companies has doubled executive travel every five years . . . the potential among firms not now using aircraft is many times greater than the simple potential for replacement aircraft within the existing market."

Some 5,000 U. S. and Canadian farmers and ranchers, belonging to the National Flying Farmers Association, own planes which they fly themselves for business and pleasure. The farmers seldom engage in aerial application work such as crop dusting, since this is a highly professional skill and generally undertaken only by commercial outfits. But they do use their planes extensively in farm and ranch chores, such as checking waterholes, rounding up cattle, and searching for strays. Flying farmers view aviation as a family affair, and entire families—fathers, mothers, sons, and daughters—often are pilots. They use the family plane as casually as any other vehicle.

Realtors use small planes to show customers large tracts of land. Contractors survey projects from the air. Professional men, such as doctors and lawyers—always short on time—have been quick to see the advantages of flying their own planes.

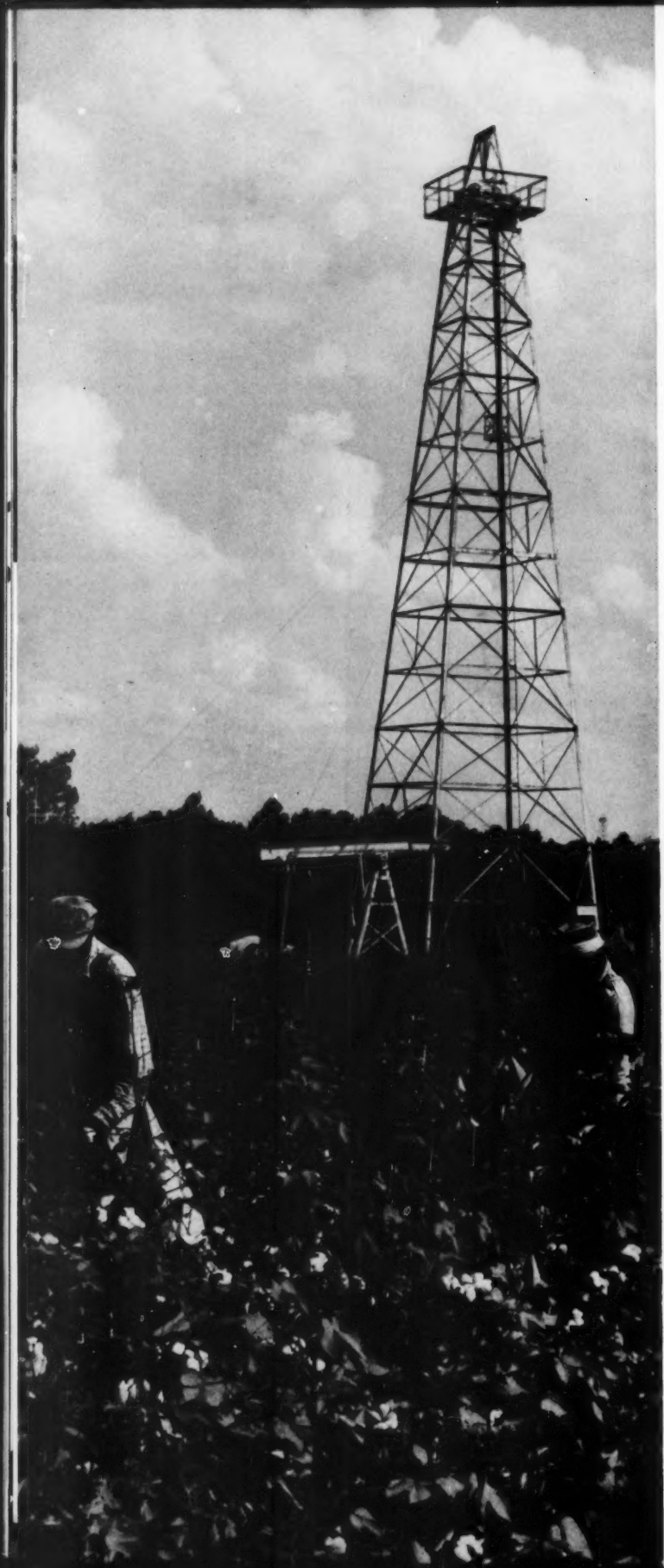
Pleasure flying by the "amateur," or "week-end pilot" as those who fly purely for fun are dubbed by the professionals, is an intriguing sport. It may have no other purpose than to perfect one's flying skill and this is rewarding enough for many amateurs. Pleasure flying may involve vacation trips or hunting and fishing expeditions to remote spots. Groups of amateur pilots frequently get together for a fly-in breakfast or fish fry. Every year, there are numerous group tours to such points as Alaska and Mexico City, and several efficiency races across the continent.

The sick and injured in remote areas are cared for by flying physicians.

There are 50 times more actively licensed pilots in this country than private planes. Since not every licensed pilot can afford to own a plane, many belong to flying clubs which cooperatively finance the purchase and operation of one or more aircraft. Such enterprises are by no means limited to sport flying. It is becoming common for small firms to form such ownership arrangements.

PHOTO CREDITS

Pages 4-7 and 24-26—George Laycock; page 8—Mobil Oil Co.; page 9—*Steelways*, published by American Iron and Steel Institute; page 10—Wide World Photos; pages 12-14—Harry Hess; page 15—(left) Ohio Oil Co.; (upper right)—Montana Chamber of Commerce, and (lower right)—F. M. Paulson; pages 16-17 — Standard Oil Co. of California; pages 18-20—William M. Beard, Jr.; pages 21-23—Baroid Division, National Lead Co.; pages 30-31—George Hunter; page 32—Alberta, Canada, government.



Oil Country U.S.A. (first of a series)

OIL IN THE

by Gene Wirth

A search for clay to make milk mugs for Mississippi school children led to discovery of oil—a resource that has brought many economic blessings to the state in the past two decades

A GEOLOGICAL survey party's search for clays suitable for molding milk mugs for school children led to the discovery of oil in Mississippi.

This year, the state marks the 20th anniversary of that piece of good fortune. For, it was, indeed, one of those occurrences that cause Mississippi folk to use the expression: "Must have been payin' the preacher."

To a people long dependent for their "bread and butter" upon the uncertainties of "King Cotton" and timber, the birth of a new industry meant a great deal. Development of the state's petroleum resources put folding money into pockets that theretofore had rattled lead washers against a couple of coppers and an occasional buffalo nickel. It put free textbooks under the arms of Mississippi school children and set a tastier table for the thousands drawing state welfare checks. It brought more and better hospital facilities for the sick and crippled and more and smoother roads into town.

Frederic Francis Mellen, a young assistant state geologist, was the first to turn up evidence of potential oil deposits in Mississippi. That was in 1938, while leading a WPA project crew on a geological mapping expedition in Yazoo County. The party was on the lookout for any mineral, but particularly clays for making milk mugs.

While working up his field notes for the final report, Mellen found he needed some additional information that would require him to return briefly to Yazoo County. Too, he realized that if his survey notes were correct, a sizeable structure favorable to oil existed in the general area around Tinsley.

It was about mid-afternoon of a wintry, Feb-

Oil is rapidly displacing "King Cotton" as one of Mississippi's leading sources of income.

LAND OF COTTON

ruary 1939 day when the geologist stumbled upon what appeared to be an outcrop of Moody's Branch marl—a marine formation—near the small community of Tinsley. The outcrop was found to be about 250 feet higher than usual. This indicated that formations beneath it were similarly displaced and that possibly there was oil somewhere below. Dr. William C. Morse, director of the Mississippi Geological Survey, was called to inspect the area. Fossils were collected for examination and two months of tests and studies followed.

Then, on April 12, Mellen dumped an armload of mimeographed news releases into the post office at Jackson, the state capital. The releases made no rash statements, but simply detailed the findings of the geological survey in Yazoo County. Newspapers carried the announcement without fanfare.

It was some 16 days later that the first oil lease was taken in the Tinsley area and several more days before the next lease was recorded. However, leasing activity gained momentum and soon the first well was being drilled. It came in on September 5, 1939, opening the Tinsley field and putting Mississippi in the column of oil-producing states. Almost overnight, the discovery attracted geologists, landmen, scouts, and other oil-field personnel. It was something new to Mississippians and their excitement generated the usual wild rumors that go with discovery of oil.

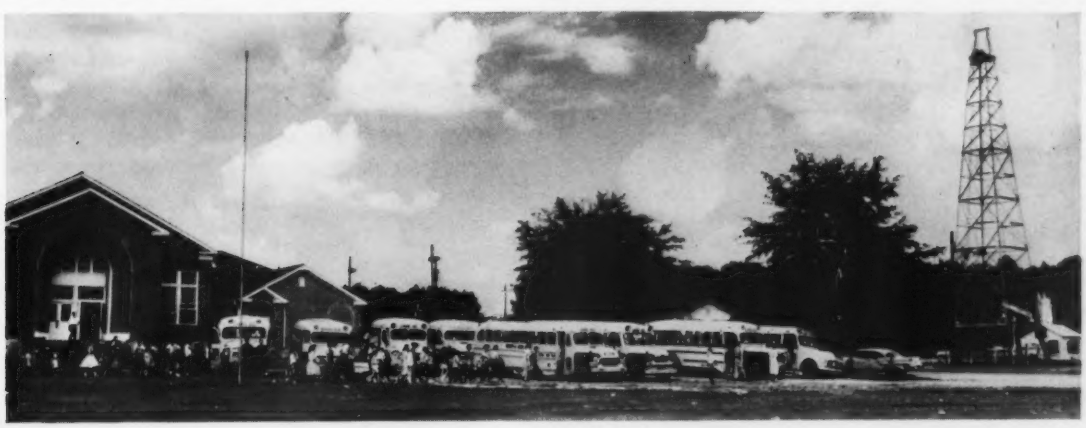
Activity was by no means confined to development of the Tinsley field. The search for oil became state-wide. But, it wasn't long before Mississippians learned that every hole sunk in the ground wasn't going to strike oil.

In March 1940, some six months after the Tinsley discovery, the Pickens field in adjacent Madison County was opened. This discovery further intensified the search for oil. But, now Mississippi was unknowingly entering her first big oil drought.

It was to be three years, millions of speculative dollars, and some 500 wildcat wells later before the next discovery was made. This was the Brookhaven field in Lincoln County, about 100 miles south of the first discoveries. Here, drilling had to go to 10,000 feet, or about twice the average depth of wells in the Tinsley and Pickens fields. And, with greater depth came added drilling costs and new problems.

Three more important discoveries were made in the same year the Brookhaven field broke the

Mississippi school children have benefited from two decades of the oil industry.



dry spell. They were the Cranfield, Heidelberg, and Eucatta fields. The years 1944, 1945, and 1946 added other significant discoveries, and the development of the older fields continued at an encouraging pace.

Steadily, though not always as fast as was hoped, new oil and gas resources have been discovered and developed in Mississippi in the ensuing years. As of January 1, 1959, the state's oil reserves were estimated at 379 million barrels. Approximately 2,500 oil and gas wells are producing from 158 fields located in 32 of the state's 82 counties. Mississippi is currently the tenth ranking oil-producing state with a production of about 40 million barrels annually. Its cumulative oil production is approximately 600 million barrels.

The Tinsley field, which now produces about 3.8 million barrels annually, was the state's pacesetter until recently when it gave way to heavier production from three southern Mississippi fields. They are the Little Creek, Baxterville, and Soso fields producing respectively 6.5 million, five million, and four million-plus barrels annually.

Some 500 or more wells are scheduled to be drilled before this year is out, and nearly 200 of these will be "wildcats" in search of new pay areas.

Oil accounts for better than 90 per cent of the state's mineral wealth and is rapidly displacing "King Cotton" and timber as Mississippi's leading sources of income. Thus, the petroleum industry's development has had a tremendous impact on the economy of the state.

More than $1.5 billion has been invested in oil exploration and development thus far. This year, some $70 million will be spent.

It is estimated that the petroleum industry picks up a tax tab of about $31 million annually in Mississippi. In addition, it collects nearly $43 million in gasoline taxes from motorists. And this revenue benefits, directly or indirectly, every section of the state. Lease payments will approximate $15 million and royalty payments another $17.5 million this year. Industry payrolls will amount to more than $50 million in 1959.

Too, the strong position of the petroleum industry has served as a magnet for attracting new business enterprises to the state. Not all these new enterprises are associated with oil, but are established in response to what is considered a more favorable business climate.

Oil industry leaders, who have engaged in the development of the state's petroleum resources, are viewing current prospects as "the brightest in ten to 15 years." Foremost among the factors responsible for this outlook is that the ratio of drilling successes to failures in Mississippi has been running higher in the past two years. Too, the 1958 legislature's action in abolishing the surtax, with the resultant savings of nearly $2 million annually to the industry, has stimulated increased investments, particularly in new area exploration.

This, then, is Mississippi's story of the "rags to riches" development of its vast petroleum resources and the promising role that the state is expected to play in the industry's future.

And, what happened to Fred Mellen?

Well, Fred wasn't one of those who "struck it rich." He continued his career as a geologist and is a private consultant in Jackson. He enjoys the gratitude of the industry and of the people of Mississippi for having uncovered evidence of the state's oil deposits and their respect for not having taken advantage of his public position to "cash in" on his findings.

Oil revenues have helped to build more and better roads throughout the state of Mississippi.

MUD

It may be a menace to everyone else, but it's precious to the oil-well driller.

by James A. Clark *Oil Columnist, Houston Post*

Thousands of bags of "mud" are used in drilling an oil well.

MUD, in its natural state, is something that apparently everyone with the exception of well-adjusted children could get along very well without. But, "mud," as the oil industry uses it, is anything but a menace.

The pumping of "mud" through the hole of a well is an integral part of a drilling operation. So much so, in fact, that "mud engineers" are an important category of oil-field personnel.

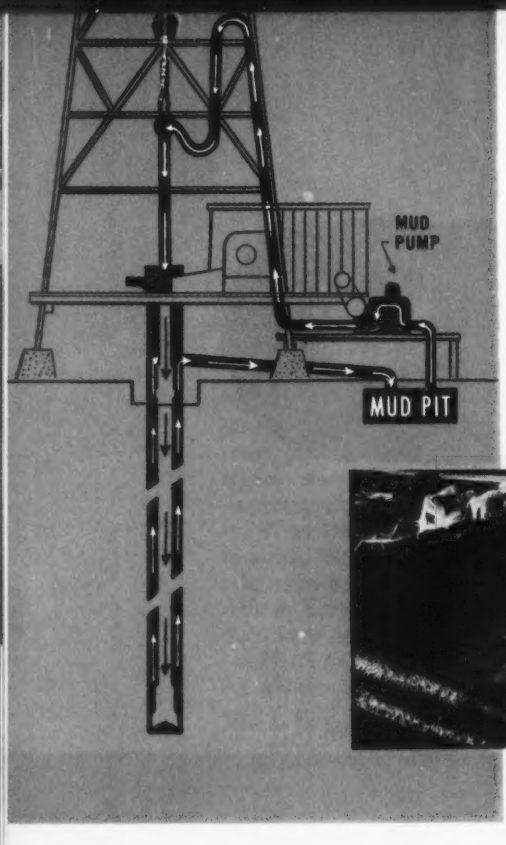
Just what is this "mud" that the oil-well drillers can't do without?

Originally, it was pure mud in the usual sense of the word—any ordinary dirt mixed with water. But now, it's a highly complex fluid composed of clays, minerals, chemicals, and a variety of additives in widely varying ratios. There are three basic types—water-base muds, oil-base, and emulsion muds.

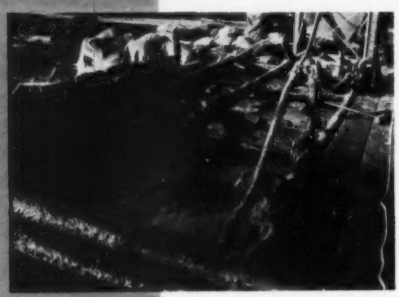
They are mixed with the skill of a pharmacist and the fastidiousness of a French chef. In other words, muds are scientifically concocted to meet the specific conditions of a given drilling operation.

Today's scientific mud-making is of humble origin. It goes back to 1901, when Curt Hamill drove a herd of Perry McFaddin's cows into a small, hand-dug water pit alongside the derrick of the well that opened the famed Spindletop field in Texas.

Where Hamill got the idea of using mud, he can't recall. The 85-year-old oilman, who lives in Kerrville, Texas, simply remembers



Mud, pumped down into the well and back to the surface to a mud pit (photo), flushes up cuttings, cools and lubricates the bit, and cakes the wall of the hole.



that he had to drill through quicksand and that thick muddy water seemed the best solution to his problem at the time.

Anyway, it worked. And, by coincidence, the mud technique came into being with the introduction of rotary drilling, the basic method of oil-well drilling that continues to this day.

Mud is big business in the oil fields today. To drill an average 10,000-foot well, more than two million pounds of mud are required. There are instances where more than $300,000 has been spent for drilling mud on a single deep well in high pressure, high temperature oil country.

Here's how the mud operation works: Once drilling begins, the mud is pumped down through the hollow center of a string of drill pipe. When it reaches the bottom, it is forced out through perforations in the bit. Then, the mud makes its way back up the space between the drill pipe and the wall of the hole (see drawing).

Mud has countless uses in drilling, but four of its functions are of basic significance:

It cools and lubricates the drill bit, speeding up the drilling process and prolonging the life of equipment;

Its circulatory system (see drawing) brings to the surface cuttings from the bottom of the hole.

It lines the hole with a filter cake to prevent sloughing or caving of the formation until steel casing is set in; (The filter cake also permits free passage of the drill stem in and out of the hole.)

It provides hydrostatic pressure that lessens the danger of blowouts and possible ensuing fires. (The mud, in effect, "sits on" formations of gas, oil, and water until the driller is ready for them to come up to the surface under his control.)

Until the late '20's, little was done to advance the mud art. Several important technical papers mentioned the subject, but the matter remained pretty much academic.

What finally stimulated the oilman's lasting interest in the mud technique was an underground formation known as "heaving shale" that was encountered at certain drilling sites on the Gulf Coast. Actually, the shale didn't heave. It simply seemed to go into some kind of convulsion when disturbed by a drill bit. The formation stuck drill pipe so firmly that derricks were pulled down trying to retrieve it. Some say it occasionally caused a joint of drill pipe to be sheared off, although no one will swear to this fact. Anyway, the heaving shale frustrated attempts to drill down into highly productive oil-bearing sands along the edge of Gulf Coast salt dome structures.

The late Miles Frank Yount, who, although self-educated, was a profound thinker in the realms of art, music, and literature, as well as in the art of drilling, was found to be having more than average success in getting through heaving shale. One day, someone revealed that he had a young engineer-geologist named Michael T. Halbouty stashed away in a little shack on the edge of the Spindletop dome mixing special muds for Yount's private use.

While Yount solved his individual drilling problem, heaving shale received the major attention of drilling service companies and the Bureau of Mines in the '30's. The problem still exists today, but to a greatly reduced degree because of the many improvements made in drilling muds.

On the west coast, oilmen had encountered so-called "caving shale" in the earliest days of drilling. At Kettleman Hills and Signal Hill, Calif., the problem of caving shale became particularly acute. In November 1928, in a last desperate effort to save the famous Ochsner No. 2 well at Kettleman Hills, about 33 tons of a drilling mud made from bentonite were brought in. The well was saved from a cave in, and the effectiveness of mud was applauded by oilmen in all U.S. fields.

The weird figure who called himself a mud engineer first appeared in the oil fields in the mid '30's. He was equipped with crude filtration instruments,

chemical reagents, mixing devices, test tubes, and pipettes. Drilling crews at first regarded him as they would a medicine man in a side show.

But, as methods, equipment, and mud preparations improved, mud engineers demanded and got respect. Today, a mud engineer (a title considered in the oil industry as most likely to stump the panel on "What's My Line?") is a key member of the oil-drilling fraternity. In fact, without him there might be no such fraternity. And, if that were true, we might all be back to driving nags along dirt roads from the seats of bouncy buggies.

Curt Hamill is still glad he chased Perry McFaddin's cows through that water pit and so is the oil industry.

Special "mud" ingredients are poured into a mixing pit.

Oil Field Word Menu

The lingo of the oil fields includes many odd and picturesque terms. A surprisingly large number of these terms relate to food, reflecting the drilling crews' preoccupation with the question: "When do we eat?" Here is a sample menu made up of words that are part of the workaday language one hears wherever a drilling crew "makes hole."

APPETIZERS

Soup
(TNT)

ENTREES

Rabbit
(A tool for cleaning out pipe)

Duck
(A portable pumper for oil wells)

Eggs
(Charges of dynamite; small cast-iron tanks)

CHOICE OF

Beans
(Valves or chokes)

Cabbage
(Bearings on a connecting rod)

Macaroni
(Big pipe)

Spaghetti
(Little pipe)

CONDIMENTS

Tabasco Sauce
(A red acid used to dissolve limestone through which a well is drilled so that oil will flow more freely into the hole.)

Catsup
(A bright red lubricant for pipe fittings—red lead.)

ROLLS AND BUTTER

Biscuits
(A sample of rock formation taken from a well, much as biscuits are cut out of dough.)

Apple Butter
(Dressing for engine belts)

DESSERTS

Watermelon
(A weight used in pumping a well)

Pineapple
(The part of a rotary bit that bites into the rock formation)

Cheese
(Paraffin saturated with oil)

Doughnuts
(Round tubing)

BEVERAGES

Coffee
(A mistake—the drilling crew member who makes one must pay the penalty of treating the others to coffee)

Thanks to progress in farm mechanization, one worker can now produce enough food for 23 people as compared to less than half that number in 1940.

AUTUMN

An almost 50 per cent increase in petroleum insecticide production since 1949 has helped farmers like Don Bernard boost their corn yield 25 per cent in ten years.

Gone is the drudgery that used to go with preparing the farm for winter.

Most farm families no longer butcher their own hogs, make their own apple butter or cider. Corn is husked by machinery and the pitchfork is out of place in the hay field. The farm wife, instead of "putting up" hundreds of jars of fruits and vegetables, buys the rest at the grocery store.

Instead of the once perpetual wood chopping, the modern farmer depends for winter heat on the fuel oil distributor. The same distributor delivers fuel for fast moving tillage and harvesting machinery which has eliminated heavy work in the field.

These are but some of the changes that have come to farms such as the 225 acre operation of the Donald Bernard family of New Vienna, Ohio. The family includes Don and his wife, Martha, their son, Doug, 16, and three daughters,

Father and son refuel their tractor, the basic farm machine. There are five million tractors in operation on U.S. farms today.

Shirley and Barbara chat with Paul Smith, local oilman, who delivers about 4,000 gallons of petroleum products each year to the Bernard farm.

Readying Thanksgiving turkeys for market, Don and his brother, Robert, fill field feeders from automatic bulk truck.

ON THE FARM

Sharon, 14, Shirley, 10, and Barbara, 4.

Don, who annually produces 5,000 turkeys, 2,000 capons, 200 market hogs, and, on a typical day, sends 5,000 fresh eggs to market, now has his farm work spread evenly over the year. There is no frantic, last minute effort to prepare farm and family for winter's coming.

The Bernards can still, however, see sure signs of approaching winter. The yellow school bus now passes the house twice a day. Children are busy with homework and basketball and making school clothes.

Outside, tractors are winterized well ahead of the advent of cold weather. Corn is picked and cribbed. Fat turkeys are trucked off to market. Storm sash are fitted to windows and muddy weather boots begin to line the back steps.

Well ahead of winter the Bernard farm and family are prepared for the change in the season.

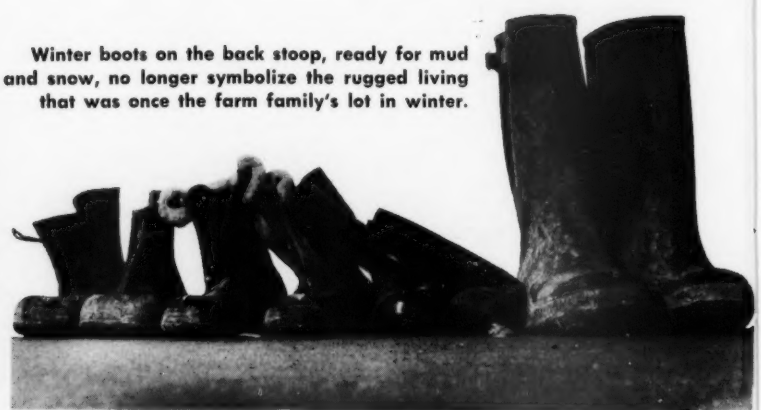
At 16, Doug has a one-half interest in the 2,000 capons raised on his father's farm.

His home kept warm with oilheat, Don puts his time to more productive use than did his wood-chopping ancestors.

Autumn is sewing time for Sharon. Here, Martha Bernard gives her daughter some expert advice.

Sharon and Doug play "catch" with a pumpkin. Teenagers have more time to enjoy autumn on the farm now that machines have eliminated many "after school chores."

Winter boots on the back stoop, ready for mud and snow, no longer symbolize the rugged living that was once the farm family's lot in winter.



THE ENERGY CHALLENGE

by Harry C. Kenney *Staff Correspondent, The Christian Science Monitor*

RUSSIA already has the edge on the U. S. in outer space, and she is striving hard here on earth to overcome the big U. S. lead in industrialization and living standards.

Any complacency about this competition should have been dispelled by the time Premier Nikita Khrushchev concluded his recent American tour. He never missed an opportunity to stress the Kremlin's ironclad determination not only to overtake us but to surpass us.

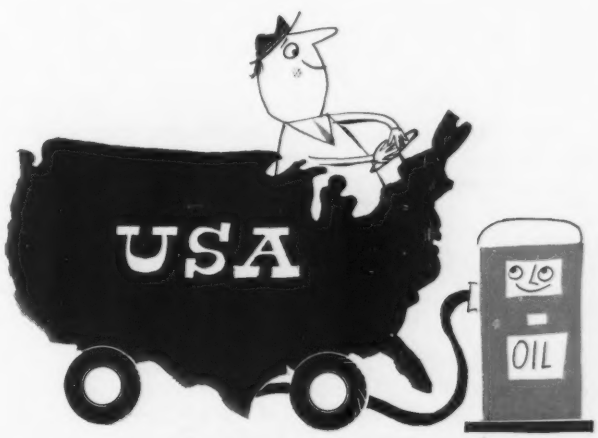
Obviously, many factors will influence the course of the competitive struggle between the world's two greatest powers for economic supremacy. But certainly one of the very basic factors will be the ability of each competitor to command the sources of energy necessary for industrial progress.

Nuclear energy appears destined some day to revolutionize the world's energy pattern. Yet its practical application is perhaps a generation or more away. Meanwhile, the material progress of nations will hinge on their ability to increase the supply of fossil fuels—coal and petroleum.

Of the two fossil fuels, petroleum is of greater future significance. The world technological trend is sharply in the direction of greater dependence on oil. In the U. S., this trend is already a half century old. Oil and natural gas now supply over two-thirds of the total energy requirements of the U. S. Moreover, by 1975, our energy demand is expected to double and the job of supplying petroleum will be twice as big. At the same time, world demand for petroleum is rising sharply as other nations seek to emulate the technological and industrial progress of the U. S.

The connection between industrial progress and ability to command sources of energy is well exemplified by the fact that the U. S., with just six per cent of the world's population and seven per cent of the land area, produces and consumes almost 40 per cent of the world's energy. This tremendous expenditure of energy spells power—militarily, economically, and politically. It is the "big stick" in the country's capability and the promise of the future.

The ability of American engineers and scientists to put this enormous supply of energy to work has resulted in the highest living standard in the world. In terms of the individual—Mrs. Smith in the kitchen or John Jones on the farm—the energy factor is of tremendous everyday importance. Some 99 per cent of the work done in this country is done by machines—everything from a can opener to a grain harvester. Annual machine energy produced in the U. S. is equal to the muscle power of nearly 163 billion people working at hard labor or about 80 times the total population of the world. Or, to put it in another way, each American has at his disposal the power equivalent of 929 workers.



Americans are now consuming 9.5 million barrels of oil daily.

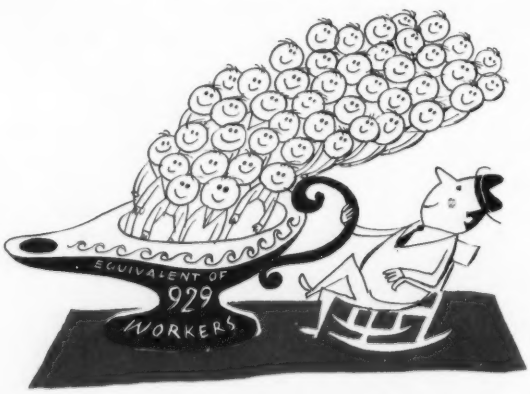
The young American nation capitalized on its reserves of coal, the source of energy that ushered in the Industrial Revolution, to get off to a good start. Steam locomotives came close on the heels of the covered wagon to speed westward expansion, and steam-driven machinery made possible a more rapid industrial build-up than any new nation had yet achieved.

Then, in 1859, Col. Edwin L. Drake drilled the

world's first commercial oil well along Oil Creek near Titusville, Pa., and opened up a new source of energy that was to carry the nation to even greater heights of material progress. In less than two generations, the fuel that made the internal combustion engine possible was to change the American way of life more drastically than a way of life had been altered in any comparable period of history.

America, of course, still had ample coal but she was free of the limitations of steam power. With her new source of energy came not only the auto, with its tremendous impact on family life, but a wide range of new machines and equipment that were to lead to phenomenal economic advances.

Take for example, the effect of the internal combustion engine on agriculture alone. While our population and national work force have been constantly rising, farm employment since 1929 has declined by 33 per cent, and the use of animals has dropped 77 per cent. During the same period, however, farm production has increased 66 per cent. In 1929, one farm worker could provide food for nine people. Now a single worker can support more than 23 people.



Each American commands a fabulous amount of energy.

During this period, the number of farm tractors in use increased from 827,000 to almost five million, and the number of farm trucks from 840,000 to three million. Of course, the effect of constantly improved fertilizers and pesticides also has been a key factor in the tremendous increase in farm productivity. And, here again oil has made a contribution with a 50-per-cent increase in production of petroleum-based insecticides in the past ten years alone.

Petroleum will soon become the world's prime energy source.

With the soaring use of petroleum, the U. S. took the world energy lead. It has been using energy for domestic and industrial purposes at a truly fantastic rate. Indeed, since 1940, Americans have used more oil and natural gas than was used by the whole human race before 1940.

World-wide, however, coal still provides more than half of the world's requirements for machine energy. But, the trend is sharply turning toward petroleum in response to the requirements of new technologies. Soon, as in the U. S., oil will become the prime energy source of the world.

Indeed, the trend toward greater use of petroleum is well on the way. In Western Europe, energy demands have risen so fast that coal and water have been unable to meet them, and oil is moving in to fill the gap. Latin America has almost no coal and little developed water power, so that its industrial future will depend on petroleum.

In total, the world is currently using some 2.5 billion tons of coal and lignite, and 6.5 billion barrels of oil each year. The 1955 Geneva Conference on Atomic Energy estimated that by the year 2000, assuming the absence of new fuels, coal will provide about 26 per cent of the world's energy requirements and petroleum will emerge as the leading supplier. It was estimated that by 2025, oil and gas would supply some 60 per cent of the world demand.

It is a foregone conclusion that the atom will one day play a major role in meeting the energy challenge to man's future. The potential of the atom as an energy source is fantastic. One pound of uranium can produce power equivalent to a million pounds of coal or 5,500 barrels of oil. And, other elements like cobalt, as yet undeveloped, add further to this great potential.

But, this source of energy must be brought into proper perspective, if we are to take a realistic view of our energy position. Current developments in nuclear power plants and nuclear-powered ships, important as they are, should not be taken as indications that widespread practical applications of atomic energy are just around the corner. Machines

of today cannot operate on the fuels of tomorrow. The engineering problems to be solved before nuclear energy can be harnessed to take over from coal and petroleum are colossal. It can be said, however, that science, industry, and government are determined to see the nuclear power development through to its high promise—and we can be sure that this is true not only in the Free World but also in the Soviet Union and Communist China.

Meanwhile, petroleum will be the focal point of the world's energy problem. So, the crucial question right now is: Will we have enough oil and natural gas to tide us over until a major new source of energy changes the picture?

Actually, the petroleum reserves of the Middle East and other parts of the world are far greater than those of the U. S. At present, U. S. oil companies are engaged in developing a major part of these foreign oil fields. Thus, the U. S. has at its command vast oil resources beyond its own shores. Over the long haul, however, it is the domestic

Atomic energy is destined for a major role. But when?

reserves that are of most concern because of the political uncertainties that surround major oil fields in the rest of the world. What, then, is the outlook in the U. S. for sustaining oil and natural gas production at levels necessary to meet sharply rising demand?

The reserve position is reassuring. In each recent ten-year period, the U. S. petroleum industry has achieved production equal to the proved reserves estimated at the beginning of the period. At the same time, it has increased its known reserves to new record levels.

The U. S. Geological Survey's latest estimate puts U. S. recoverable reserves at 300 billion barrels. Other recent estimates have ranged as high as 500 billion barrels. Thus, notwithstanding foreign reserves currently under American production, the U. S. is potentially well off.

There's enough oil but it's getting more difficult to find.

But, unfortunately, there's another side of the story that is less comforting. The odds on finding new deposits become progressively unfavorable. Statistics on exploration drilling or "wildcatting" show that eight out of nine wells drilled are dry. Moreover, only one in 49 fields contains a pool big enough to make production commercially attractive.

The fact that drilling costs also have risen substantially accentuates the problem still more. Cost of extracting a barrel of oil in the U. S. has gone up from $1.14 in 1948 to $1.95 in 1957, a 71 per cent jump.

The first oil well came in at a depth of only 69½ feet. Today, the average well is about 4,000 feet deep, and many have been drilled to a depth of four miles or more. It costs about $12 a foot to drill to 4,000 feet, and then the cost rises in proportion as the well goes deeper. Below 15,000 feet, cost of drilling averages about $154 a foot. Drilling costs ranging from $500,000 to $1 million per well are fairly common.

The upshot of it is that this country has reached the end of easy supplies of petroleum. Though oilmen are confident that the towering demand of the nation can be met, the fact remains that new supplies are going to be more difficult to locate and far more expensive to tap.

Whether we or the Russians are the first to send visitors to the man in the moon, the energy race on earth will go on unrelentingly. For many years to come petroleum will be the focal point of the energy problem, and then the competition will center on atomic energy, solar energy, and perhaps even more powerful and exotic sources yet to be discovered.

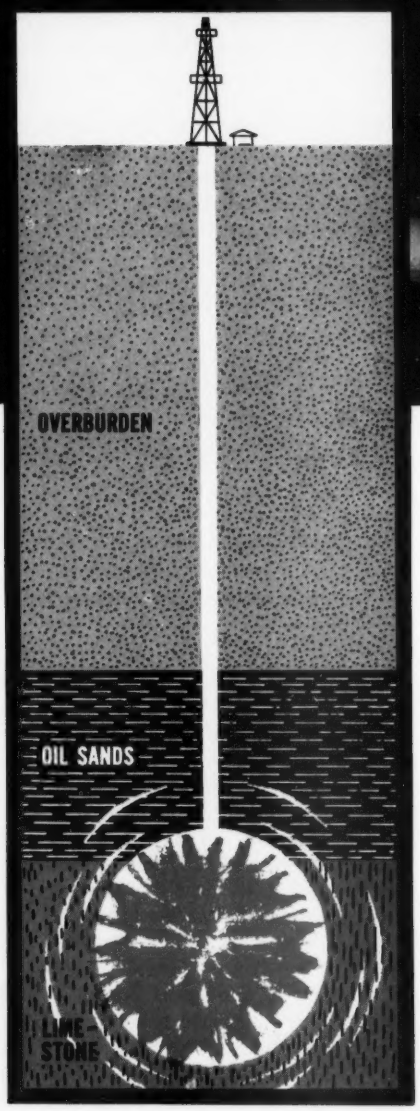
An attempt will be made to free oil trapped in a strange deposit known as the Athabasca sands, in the wilds of northern Canada by an...

UNDERGROUND ATOMIC BLAST

by John S. Peach

Sometime during 1961, a dull thud from a nuclear explosion deep underground will disturb the silence of the wilderness west of the Athabasca River in the northern part of the Alberta Province of Canada.

If the blast is effective, it will free the oil trapped in the Athabasca sands, and a breathtaking new chapter in the petroleum industry will begin. If not, the industry will be richer by the technology gained from the experience, and will be able to put this new knowledge to work on future efforts.



The Athabasca oil sands, known as the McMurray formation, are located within an area of 30,000 square miles. They constitute what is believed to be the largest, single untapped oil reservoir, with reserves estimated at 300 billion barrels, or about 25 billion barrels more than the proved oil reserves of the world.

(Oil shale deposits scattered over Colorado, Utah, and Wyoming are estimated to contain an aggregate of 1.1 trillion barrels of petroleum. The feasibility of using underground nuclear detonations to free the oil from these deposits is also under study. Indeed, a proposed nuclear explosion which would be detonated in an oil shale deposit in western Colorado is in the planning stage, with the U. S. Atomic Energy Commission, the nation's petroleum industry, and the U. S. Bureau of Mines collaborating.)

Knowledge of the Athabasca sands can be traced back to Peter Pond, a soldier, trader, explorer, and self-sustained philosopher who established a fort and trading post for the Northwest Company on the Elk River in the Athabasca region in 1788. Pond, a native of Milford, Connecticut, shared his knowledge of the strange black deposits with Alexander Mackenzie who was searching for a practical trading route to the Pacific Ocean. Mackenzie noted: "There are some bituminous fountains, into which a pole of twenty feet long may be inserted without the least resistance. The bitumen (tar) is in a fluid state, and when mixed with gum, or the resinous substances collected from the spruce fir, serves to gum the canoes. In its heated state, it emits a smell like that of sea-coal. The banks of the river, which are there very elevated, discover veins of the same bituminous quality."

The oil sands are exposed to the light and air in some places. In other places, a mantle of gravel, boulders, clay, and in some instances, sandstone, lies 8,000 feet thick above the oil-soaked sand.

The depth of the deposits themselves varies in thickness, too. The sharply cut banks of the north-flowing Athabasca River reveal a ribbon of limestone which rises and dips above and below the water level. Above it, the oil-sand cliffs tower as high as 200 feet. The richest deposits are prehistoric sandbars overlaid by what is known as the Clearwater Shale—a tightly packed formation devoid of oil. A good example of such a deposit is located on the Mildred-Ruth Lakes area west of the Athabasca River, where the sandbar covers four-and-one-half square miles. Having an overburden of no more than 75 feet thickness, the sandbar is estimated to contain in its oil-saturated depths about 900 million barrels of high-grade oil.

It is in this region that the projected experiment will be carried out. What is planned is this: A 36-inch hole will be drilled 1,200 to 1,400 feet down, through the overburden, through the 200 or so feet of oil sands strata and interlaid clay and rock, down into the "basement" limestone. A nuclear explosive will be lowered into the hole and fired. The effect is expected to be little more than a localized thud. But below the surface of the wilderness, a most awesome transformation is expected to take place.

Suddenly, heat of about ten million degrees fahrenheit will burst upon the oil sands, upwards from the "basement" limestone. The surrounding formation will become a swirling mass of rock immediately transformed into gas and a hollow ball perhaps as large as 250 feet in diameter, is expected to be formed.

So great will be the heat and the pressure within the cavern of the hollow ball, that almost in an instant the surrounding wall of shale and sand will be fused into glass. This bubble-like creation is expected to collapse—as it did in somewhat similar U.S. experimental blasts in Nevada—with the fractured oil sand formation tumbling to the bottom. It is not expected that any radiation will escape from this suddenly-created "tomb" deep underground. The heat from the blast will continue to seep through the oil-sand formation above and beyond the sphere for months.

This heat is the key to the whole plan. Each grain of sand in the Athabasca deposits is coated with oil so sticky that hitherto no standard type of underground heat generation has raised the temperature of the oil sufficiently to cause it to flow free of sand grain. The extreme heat of the nuclear explosion is counted upon to make the oil free-flowing through the porous formation. Then, by the use of normal oil-well equipment the deposit will be drilled, and the oil pumped to the surface.

The art of mechanically separating oil and sand has been developed to such a degree that 95 per cent extraction of the oil from mined sands is theoretically possible. But the mechanical methods so far developed, such as washing, rinsing, whirling, cooking, and otherwise separating the oil and sand re-

Each grain of Athabasca sand is coated with oil.

Open pit mining can recover about two per cent of the estimated reserves of the Athabasca sands.

quire hot water or some other heated separating agent. It is the heat loss in great measure that has ruled out mechanical means as uneconomic in these days of still readily available normal oil sources.

Open pit mining has been carried on at riverbank sites at sporadic intervals for many years. At some of these places, the oil sands are 160 feet thick with a thin overburden of plant growth and gravel of no more than 15 feet in depth. Oil sand containing about two to three billion barrels of oil is recoverable by open pit mining. But this amounts to only about two per cent of the estimated oil reserves.

As early as 1925, an imaginative pioneer oilman conceived the idea of using heat to free oil from a deep-lying bed of oil sand. First, he tried to make the oil free-running by injecting steam into the formation. When this method failed to yield results, the ingenious developer created a combustion chamber at the base of a bore hole.

He fed a mixture of gasoline and air into little cavities deep within the oil sands and set fire to it. Every time the fire dwindled, he gave it a shot of kerosine. It is reported that he did succeed in creating a most awesome pillar of inky black smoke that caught in the wind and drifted down the Athabasca valley for many miles. After two days, it became apparent that the oil sands were having no part of this treatment, and the experiment was abandoned.

Although underground nuclear blasts have been detonated in Nevada, so far no such test ever has been carried out in a formation like that of the Athabasca oil sands. There are widely conflicting estimates of the effectiveness, blast cost, and oil recovery cost. One government official, for example, believes that to liberate from two to six billion barrels of oil—only half of which, he thinks, will be recoverable—will take over ten million ten-kiloton nuclear explosions at a total cost of approximately $10 trillion. If this estimate is applied to the known reserves of the Athabasca deposits, oil at the point of recovery would cost approximately $36 per barrel! On the other hand, the oil company financing the experiment estimates that a $500,000 nuclear device will make available a sufficient quantity of oil to make its cost only one dollar a barrel at the wellhead. Such is the speculation and the theory, none of which can be verified or denied until a bomb, ranging in size from two to ten kilotons (equivalent in energy to 2,000 to 10,000 tons of TNT) is exploded to "see what happens"—for in truth nobody knows what the complete result of the test will be.

One thing is certain—there will be no shortage of experts when the plans pass their final stage, and the scientists and technicians assemble their equipment west of the Athabasca River. The petroleum exploration company backing the initial experiment is working closely with: the U.S. Atomic Energy Commission from which the nuclear device must be secured; the University of California's Lawrence Radiation Laboratory; Atomic Energy of Canada, Limited, Canada's counterpart to the AEC; the Canadian government's National Research Council; the Alberta Research Council (pioneers in oil sands experiments of many types), and Canada's Department of National Health and Welfare, which is concerned with the radiation aspects of the blast.

Those in charge of setting up the Canadian experiment are relying heavily on what was learned from the nine known United States underground nuclear explosions carried out thus far.

Even when modern seismic instruments and geophysical survey techniques show highly promising indications of an oil deposit, the financial risk in drilling is always great. The same element of risk is strong in the forthcoming Athabasca sands experiment, despite the fact that the formation is latent with oil. For no one can be sure the oil can be extracted by nuclear means or, if so, in a quantity that will yield proceeds at prevailing market prices sufficient to cover the cost of recovery. U. S. offshore drilling operations, for example, are so difficult and costly that the output of oil is thus far way short of break-even return on investments.

But, only by pioneering new ideas and techniques as exemplified by the Athabasca venture, can the petroleum industry guarantee that the growing demand for its products can be adequately met over the long haul.

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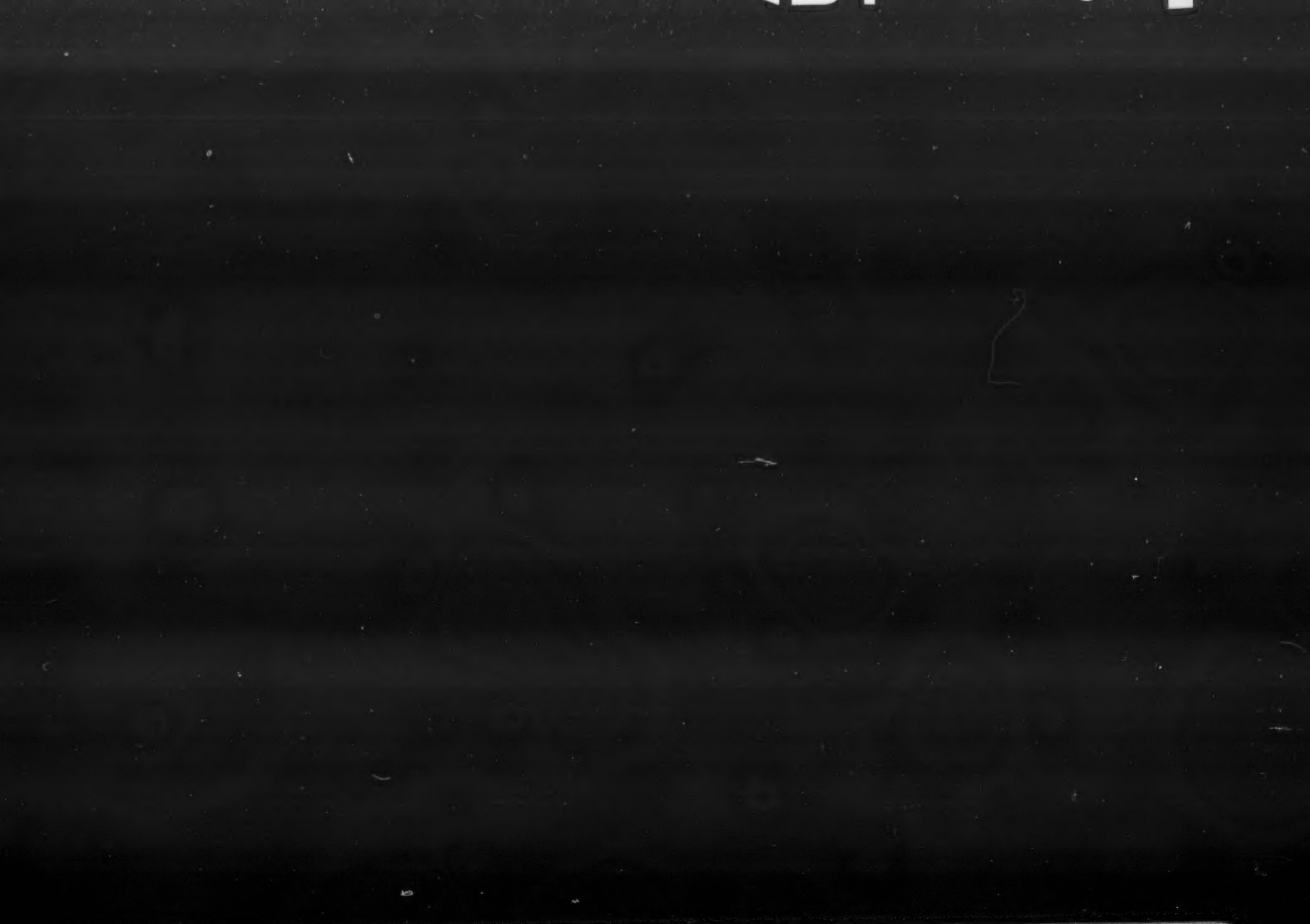
Crewmen of an Ohio River towboat tussle with heavy hose used to pump crude oil from barges.